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The Development of Scientific Cooperation under the Norway–Russia Fisheries Regime in the Barents Sea

Maria Hammer and Alf Håkon Hoel

Maria Hammer is Ph.D. candidate, Department of Political Science, University of Tromsø. E-mail: maria.hammer@uit.no.

Alf Håkon Hoel is Regional Director, Institute of Marine Research, Tromsø. E-mail: alf.haakon.hoel@imr.no.

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Abstract: Cooperation between Norwegian and Russian scientists on marine science in the Barents Sea dates back to the 1950s. Science, as well as the resource management it serves, has evolved dramatically since then. In terms of its substance, scientific foci and methods have increased substantially. Previously, research efforts targeted a few commercial fish species, whereas entire ecosystems and non-commercial as well as commercial species are addressed today. A further dimension of change is that of organization of science: While cooperation was initially sporadic, it has gradually become embedded in a wider framework of scientific collaboration and become more organized. This framework is included in the bilateral management of the living marine resources in the Barents Sea. The Norwegian–Russian Joint Fisheries Commission (JNRFC) and the International Council for the Exploration of the Sea (ICES) work as the peer reviewers of science and providers of scientific advice to the authorities in Norway and the Russian Federation. This article discusses these issues with regard to developments in science, in international regimes and the role of science in policy-making.

Keywords: Scientific cooperation Norway–Russian Federation, fisheries management, Barents Sea

1. Introduction

In a world of fully utilized fish resources,[1] the management regime for the fisheries in the Barents Sea stands out as successful in having ensured the sustainable development of the most important commercial fish stocks.[2] A central reason for this state of affairs is the long-standing scientific cooperation between Norwegian and Russian/Soviet scientists. Dating back to the 1950s, this scientific collaboration has evolved to provide the scientific knowledge on which the management system operates.[3] This is a long-standing cooperative venture in marine science, and as such an interesting case in the study of international scientific cooperation. It is also notable in terms of the results delivered, and can offer insights to the science policy literature[4] on the factors that explain successful translations of science into policy.

This article accounts for developments in the Barents Sea cooperation. How has this scientific cooperation developed since the mid-1950s? Further: To what extent has the scientific cooperation been influenced by scientific developments and its role in providing the scientific knowledge for policy-making?

We examine the gradual expansion of the scope of cooperation – from efforts involving a few, commercial species of living marine resources to entire ecosystems, including non-commercial species. There has also been a major evolution in the scientific methods used. We will also look at the role of science in the bilateral fisheries management regime and its development with regard to activities, as well as external cooperation through the International Council for the Exploration of the Sea (ICES).

Studies on international scientific cooperation have dealt with various marine science organizations, among them the ICES[5] and the scientific cooperation under Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR).[6] Analytical issues emerging from these studies include the role of developments in science itself as a factor in explaining change. Another issue is how scientific work is embedded in a broader institutional framework.[7] Increasingly,

1. FAO 2010: 8: in 2008 only 15% of the stocks monitored by FAO were underexploited; 53% fully exploited; and 32% overexploited.
2. See the ICES website for the development and status for cod, haddock, capelin and herring. These are currently all at healthy levels. http://www.ices.dk/advice/icesadvice.asp, accessed 10 March 2012.
3. Haug et al., 2007:7.
4. Andresen et al., 2000, and Pielke 2007.
5. Wilson 2009, Andresen and Østreng 1989.
6. CCAMLR also has a regulatory mandate.
7. Knol 2009, Østerblom and Sumaila 2011.

attention is directed toward the science/policy interface: How is science translated into policy?[8]

Fisheries science underwent substantial developments during the 20th century.[9] The realization that year-classes vary in abundance marked a milestone in the development of fish stock assessment. The discovery that one could determine the age by *otoliths* (ear stones) or fish scales made it possible to monitor the strength of year-classes and therefore also the entire population of a given fish stock.[10]

Acknowledging that exploitation could lead to stock collapse resulted in a change in the role of science in fisheries management, from being fish-finders for the industry towards providing the scientific basis for regulatory measures.[11] Models and methods for estimating the effects of fishing on the fish population emerged. The Russian scientist Fyodor I. Baranov had developed an equation on the impact of fishing as early as in 1926, and this was used in further works.[12] In 1957, Raymond J. H. Beverton and Sidney Joseph Holt published a seminal work introducing the concept of Maximum Sustainable Yield (MSY);[13] and in 1965 Virtual Population Analysis (VPA), a model for monitoring the importance of each year-class in the fishery was published.[14] The VPA model is still central to most of the stock assessment underlying the management of fisheries in the Barents Sea and the entire ICES area. In the beginning, only commercial data were used in the models, later supplemented with data from scientific surveys.[15]

After a brief account of methods, we present a description of the ocean area and its activities, followed by the institutional context of the scientific cooperation. The account of scientific developments is organized into three time periods. The first starts in 1965, before the cooperation was formalized, and lasts until 1980, when the basic structures of the cooperation had fallen into place. The second phase covers the period from 1980 to 1998, a time characterized by a substantial evolution in management as well as the science underpinning it. In 1998, a multispecies model was used for the first time to set the Total Allowable Catch (TAC) for capelin. The last period stretches from 1998 until the present. Particularly the latter part of this period has been influenced by the introduction of the ecosystem approach to the

8. Pielke Jr. 2007, Knol 2011.
9. Garcia and Charles 2008.
10. Nakken 2008: 64.
11. Schwach 2000: 309.
12. Angelini and Moloney 2007: 77.
13. Beverton and Holt 1993 (1957).
14. Gulland 1965.
15. Schwach 2000: 289.

management of living marine resources. The following discussion and conclusion relates in large part to the increase in complexity and scope.

2. Methods and Materials

The information in this article is drawn from scientific programmes and reports produced by the two research institutes that play the main role in the developments accounted for here: the Institute of Marine Research (IMR) in Norway, and the Russian Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO). Interviews have been conducted with IMR scientists, mainly to explore the issue area and identify the issues in focus here.[16] Additionally, the relevant literature has been consulted to provide material to account for the context of the scientific cooperation.

3. The Barents Sea and its Fisheries

The Barents Sea is situated between 70 and 80 degrees N. latitude, to the north of the Norwegian mainland and Northwest Russia. It borders on the Arctic Ocean in the north, and is delimited by the Norwegian Sea to the west. (See map.)

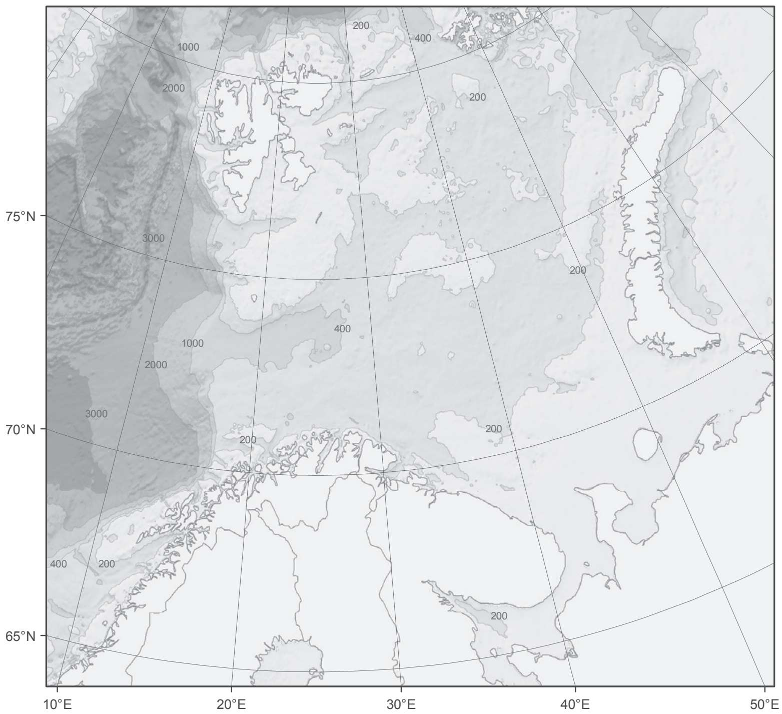

Figure 1: Map of the Barents Sea.[17]

16. We wish to thank the scientists at the IMR for their participation and enthusiasm in interviews.
17. Copyright: Norwegian Institute of Marine Research, April 11, 2012.

The Barents Sea area covers 1.4 million km^2 and is characterized by high biomass production.[18] Upwelling generated by the Atlantic current and the inflow of warm water from the southwest stimulates the growth of phytoplankton, which serves as food for zooplankton, including krill.[19] Zooplankton forms a link between the primary production of phytoplankton and fish, mammals and other organisms at higher trophic levels.[20] The Barents Sea ecosystem is closely linked to ecosystems to the south along the Norwegian coasts and to the Norwegian Sea.

There are more than 200 fish species in the Barents Sea. Key species in the ecosystem are capelin *(Mallotus villosus)*, herring *(Clupea harengus)* and cod *(Gadus morhua)*. Capelin preys on zooplankton, herring preys on zooplankton and capelin larvae, and cod prey on capelin, herring and smaller cod. Capelin is a key transporter of biomass from the northern to the southern regions of the Barents Sea. It feeds on zooplankton near the ice edge before it travels south. Herring spends its early life stages in the Barents Sea, and then migrates south into the Norwegian Sea, where it is subject to one of the world's largest fisheries. Cod is the most important predator among the fish species of the Barents Sea ecosystem, and also by far the most commercially important species. Other commercially important fish stocks include haddock *(Melanogrammus aeglefinus)* and Greenland halibut *(Reinhardtius hippoglossoides)*. Shellfish fisheries include shrimp *(Pandalus borealis)* and King Crab *(Paralithodes camtschaticus)*. There are about 25 species of marine mammals in the Barents Sea, and these consume up to 1.5 times the amount of fish caught in fisheries.[21] Harp seals *(Pagophilus groenlandicus)* and minke whales *(Balaenoptera acutorostrata)* are harvested commercially.

Climate variability and change affect the ecosystem in the Barents Sea. Changes in ocean temperatures and salinity can affect populations of fish and their habitat, which fluctuate in response to such changes.[22]

Human activity in the Barents Sea includes fishing, transport, petroleum-related activities, tourism, military activity and an emerging bioprospecting industry. Since the commercial fish stocks are such important ecosystem components, fishing has an effect on the functioning of the ecosystem in general.[23] Trawling impacts the productivity and diversity of benthic organisms and the selective nature of fisheries may result in selection pressure and ecosystem changes.[24]

18. Ellingsen et al., 2008.
19. Ingvaldsen and Røttingen 2005.
20. Stiansen et al., 2009: 13.
21. Ibid.,15.
22. Cianelli et al., 2007.
23. Stiansen 2009: 16.
24. Ibid., 276.

Cod and haddock are fished by trawl, Danish seine, hand-line, and purse seine. In Norway, capelin is fished mainly with purse seine, whereas Russian fishers use generally pelagic trawl. While most of the Norwegian cod quota is fished by passive gear such as nets, hand- and longline and Danish seine, the Russian quota is mainly fished by demersal trawl.[25] The various fisheries have fluctuated over time. The mean long-term level of cod catches from 1946 to 2002 was 700 thousand tonnes, but with variations. The average catch during the 1950s was 850 thousand tonnes, but the 1990 all-time low was 212 thousand tonnes. In 2008 the catch was closer to 500 thousand tonnes,[26] and for 2012, the TAC has been set to 751 thousand tonnes.

Oil and gas development is still relatively limited, but the Barents Sea is likely to become an important area in this respect.[27] The transport of oil and gas has increased in recent years, and seems set to expand further in the years to come, representing a risk of accidents and oil spills.[28]

4. The Institutional Context of the Research Cooperation for Marine Resources in the Barents Sea

Science does not unfold in a vacuum. The research cooperation between Norway and Russia in the Barents Sea has evolved along with major changes in the institutional context for resource management. In particular, developments in the law of the sea in the 1970s brought substantial changes in the rights and obligations of coastal states.

The global order of the oceans is defined by the Law of the Sea, the centrepiece of which is the 1982 Law of the Sea Convention. It provides a comprehensive set of rules for how the oceans are to be divided, used and managed.[29] An important feature of the 1982 Convention is the establishment of 200 nm Exclusive Economic Zones (EEZs) where the coastal states have sovereign rights over the natural resources.[30] On the high seas beyond 200 nm, states have a duty to cooperate in the conservation of living marine resources[31] and the 1995 UN Fish Stocks Agreement provides management principles, rules for regional cooperation, enforcement measures and provisions for dispute settlement for fisheries on the high seas.

25. Riksrevisjonen 2007–2008.
26. Stiansen et al., 2009: 89.
27. AMAP 2009: 75.
28. Bambulyak and Frantzen 2011.
29. Churchill and Lowe 1999.
30. The EEZ regime is laid out in part V of the Convention.
31. Burke 1994.

The global framework of international agreements has implications for marine scientific research. Directly, the agreements contain rules and principles regarding scientific activities. Essentially, the management of living marine resources is to be based on the best available science. The agreements introduce new obligations, principles and standards for resource management, and these require enhancements and increased efforts in science.[32]

In the Barents Sea (see map) developments in the Law of the Sea have brought extensive changes to how living marine resources are managed. First of all, almost the entire area fell under the jurisdiction of the two coastal states, Norway and the Russian Federation (then the Soviet Union). Only an area to the Northeast in the Barents Sea, known as "the Loophole" remained high seas.

Second, as a consequence of this, with extended jurisdiction the coastal states obtained the authority to manage resources in a much larger area. The traditionally large third-country fisheries in the area were scaled back, leaving more of the available resources for the coastal state fisheries. However, EU countries and others retained a share of the quotas in the North.

Third, a complex set of bilateral and trilateral fisheries arrangements were developed, to provide for cooperation on the management of shared and straddling fish stocks. Most major fisheries take place on fish stocks found in the maritime zones of two or more countries, and some fisheries also occur on the high seas. These multilateral arrangements vary in permanence and complexity.

The arrangement of longest standing, and by far the most important one, is the Joint Norwegian–Russian Fisheries Commission, established in 1975 to manage the fish stocks in the Barents Sea that are shared between the two countries. The Commission sets TACs for these stocks, and also exchanges quotas on several other species, including some marine mammals. Norway has bilateral fisheries agreements with the EU,[33] the Faroe Islands, Iceland, Greenland, and others, as does the Russian Federation.

While the fisheries in the waters under national jurisdiction are managed by the Joint Commission, fisheries in waters beyond national jurisdiction are to be managed by regional fisheries management organizations or arrangements (RFMO/As) and flag states. The Northeast Atlantic Fisheries Commission (NEAFC) manages the high seas part of straddling fish stocks like Atlantic herring, blue whiting and mackerel in the Norwegian Sea.[34] For marine mammals, the International Whaling

32. The UNFA, if taken literally, would at the time of its signature in 1995 have spurred increased research needs, inter alia in ecosystem interactions.
33. In line with the EU's Common Fisheries Policy, member countries transfer the authority to manage fisheries to the Union.
34. http://www.neafc.org/, accessed March 10, 2012.

Commission (IWC) and the North Atlantic Marine Mammals Commission (NAMMCO) constitute the multilateral forums for management.

Fundamental to all management of living marine resources in the Northeast Atlantic is the work of the International Council for the Exploration of the Sea (ICES). Established in 1902, ICES provides scientific advice on the management of living marine resources and the marine environment in the North Atlantic.[35] Based on the science carried out in research institutions in member countries, ICES working groups assess the status of living marine resources and the marine environment. From these assessments, the ICES advisory committee formulates advice on catch quotas and other regulations to member states and international commissions. The work of ICES involves more than one thousand scientists, and is essentially a large peer review process. In this process the scientific work carried out at domestic levels is subjected to international quality control, which serves to enhance the authority and legitimacy of scientific advice in the ensuing political decision-making processes where actual management measures are determined.

Prior to the establishment of the Joint Commission in 1975 there had been a multilateral cooperation on fisheries management in the Northeast Atlantic, which was rather unsuccessful.[36] After the Joint Commission was established, a bilateral agreement on the reciprocal fisheries relationship was entered into in 1976. EEZs were established in Norway in 1977 and in the Soviet Union in 1984.[37] Since the two countries did not agree on a boundary in the Barents Sea, an interim arrangement (the "Grey Zone") was established in 1978 to provide for enforcement of regulations against third countries in the disputed area of the Barents Sea. In 1993 the parties appointed a Permanent Russian–Norwegian Committee for Management and Enforcement cooperation within the fisheries sector. Matters relating to enforcement and IUU (illegal, unreported and unregulated) fishing have been central on the Joint Commission's agenda, although they have become less prominent in recent years.

Until 2011, the international fisheries regime for the Barents Sea has essentially been built around these three institutional building blocks: the Joint Commission, the 1976 reciprocal agreement and the Grey Zone agreement. In 2010, the two counties agreed on a boundary line in the Barents Sea. A revised fisheries agreement forms part of the agreement that went into effect in July 2011, essentially maintaining the features of the former fisheries regime.

35. See ICES homepage.
36. Christensen and Hallenstvedt 2005: 194.
37. Decree of 10 December 1976. The Soviet Union originally established a 200-mile fishing zone in the Barents Sea in 1977, which was replaced by a 200-mile EEZ in 1984.

Work under the Joint Commission has centred on the management of three fish stocks: cod, haddock and capelin. The first two are shared 50–50, while the third is shared 60–40 in favour of Norway. These early agreements from the 1970s on the sharing of the TAC have been of fundamental importance for the joint management of the stocks. From 2009 on, also Greenland Halibut is considered as a shared stock, with a 51–45–4 Norway–Russia–third country split of the TAC.

The Commission meets annually, considers the scientific advice from ICES, and sets TACs for the shared stocks. About one tenth of the TAC is set aside for third countries: the Faroe Islands, Greenland, the EU, and Iceland. In addition, Norway and Russia exchange quotas on several other stocks. The Commission also decides on the science programme for the following year, cooperation on enforcement, and other issues.

Actual management of the utilization of living marine resources takes place at the domestic level of governance. With Norway, as well as in other countries of the Northeast Atlantic, the scope of action at the domestic level of governance is circumscribed by decisions made in bilateral negotiations and international commissions. Essentially, how much can be harvested of any resource is determined in international negotiations. The issue at the domestic level of governance, then, is to implement what has been decided in international arrangements. Thus the fisheries management regime should be viewed as a multilevel regime, where important principles and their translation into actual management are set at the international level. This provides a particular logic to management, circumscribing the scope of action at the domestic level and stipulating principles that domestic policy must follow.

5. The Evolution of Scientific Cooperation: Substance

5.1. Scientific institutions

The two main institutes that research and monitor the Barents Sea regularly are the IMR and PINRO. Additionally, the Russian Federal Research Institute of Fisheries and Oceanography (VNIRO), participates on a less regular basis.

The main tasks of the IMR, established in 1900, are to provide management advice to the Norwegian authorities with regard to the management of aquaculture and the ecosystems of the Barents Sea, the Norwegian Sea, the North Sea and the Norwegian coast. The IMR is a research institute partly funded by the Norwegian Ministry of Fisheries and Coastal Affairs, and its activities are geared to providing scientific advice for the management of Norway's oceans. The IMR was a subdivision of the Norwegian Directorate of Fisheries until 1989, when it was established as an independent institution.

The main objective for PINRO is the development of scientific advice and forecasts for fisheries. Additionally, it functions as a centre for training scientists. Established in 1921, it is the oldest scientific institution in northern Russia.[38] PINRO is a global-scale research centre.[39]

In 1955, after more than 40 years, the Soviet Union resumed its membership in ICES.[40] Norway had been a member since the organization was set up in 1902.[41]

5.2. 1965–1980: Establishment of the Cooperation

In 1965, the first joint Soviet Union–Norwegian 0-group survey[42] was conducted. It included all the commercial species in addition to hydrographical and oceanographic observations such as depths, temperatures, salinity and currents.[43] The aim was to measure annual abundance and recruitment mechanisms.[44] Declines – combined with a predominance of young fish – in catches pointed to fisheries as a factor behind the fluctuations.[45] Here it should be noted that fisheries management as we know it today[46] is a recent phenomenon and did not exist at the time.

By 1969 the collapse of the Norwegian Spring-Spawning (NSS) herring stock was a fact.[47] ICES had since 1960 recommended various management measures, including greater mesh sizes and closing areas for fishing, in order to protect the cod from that fate.[48] All the same, the situation for the Northeast Arctic cod stock was worrisome towards the end of the 1960s. At that time, scientific estimates were based on commercial catch data, which gave no information on the year-classes prior to the fish entering the fisheries at the age of 3 to 5 years. There was, there-

38. It succeeded a research institute that was established in 1921.
39. http://www.pinro.ru/n22/index.php/en, accessed March 11, 2012.
40. Schwach 2000: 289.
41. Jakobsen and Ozhigin 2011: 19.
42. Ibid., 557. Fishing experiments with trawl are combined with echo-sounding. Used as indication of future recruitment due to a proportional relationship between 0-group abundance of a year-class, and the abundance of the same year-class at greater ages.
43. Nakken 2008:122.
44. Røttingen, Gjøsæter and Sunnset 2007. Successful results of echo-soundings of fish fry (0-group) had led ICES to recommend that joint surveys be undertaken on herring in the Barents Sea in 1964.
45. Nakken 2008: 65; Schwach 2000: 287.
46. Information is based on annual assessments on fish stocks leading to quota regulations.
47. Schwach 2000: 295.
48. Nakken 2008: 107.

fore, a need for independent data on young fish, and this led the IMR to initiate acoustic surveys on young cod and haddock early in the 1970s.[49]

The 1970 year-class of cod, the largest ever recorded, provided increased catches for some years. Scientists had failed to predict this, a fact that resulted in reduced confidence in scientific advice. In addition, the international managerial structures, with NEAFC setting the TACs, were far from optimal. The situation for the cod stock during the 1970s and early 1980s was even worse than predicted.[50] In the midst of this, Norway and the Soviet Union expanded their jurisdiction in response to developments in international law,[51] and became jointly responsible for the shared bio-resources in the areas.[52] The long-term development of the cod stock biomass is shown in figure 2.

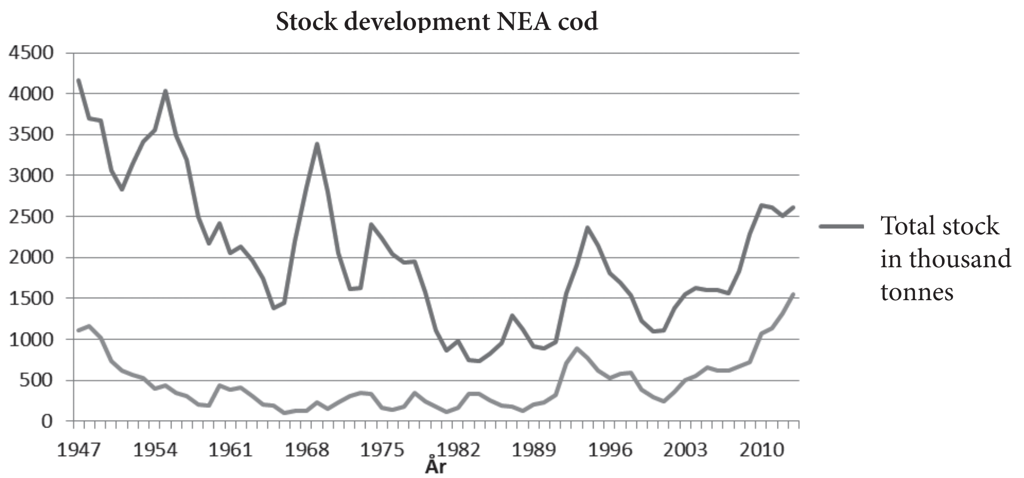

Figure 2: Stock development for North East Arctic cod.[53]

After 1970 the herring lost its prominent position in scientific discussions, and the focus shifted towards cod and capelin.[54] At the same time, the survey activities of the joint research increased, and in 1970 it was decided to continue the joint 0-group survey into the future and produce a time-series. To enable comparison of results from year to year, an index of abundance was produced.[55] Also, the

49. Nakken 2008: 108.
50. Ibid.,107.
51. Norway did so in January 1977; the Soviet Union established a fishery zone in 1977, preceding the EEZ in 1984.
52. Jakobsen and Ozhigin 2011: 32–33.
53. Source and copyright: IMR.
54. Schwach 2000: 310.
55. Nakken 2008: 126. A relative measure of the size of a population that has been statistically treated the same way every year, and can give valuable long-term information.

acoustic capelin surveys were conducted jointly by Norwegian and Russian scientists from 1975, although data processing was carried out separately.[56] In 1979, when the capelin had been defined a shared stock, this survey officially became part of the joint scientific tasks between Norway and the Soviet Union.[57] The surveys were conducted both inside the Russian waters and the Norwegian waters; sometimes Norwegian scientists conducted surveys in REZ, and vice versa. This was unproblematic.

Traditionally the Russian scientists had a wider approach in terms of ecosystem interactions, and in 1978 they brought data on ecosystem science to a joint scientific meeting. Among these was a time-series of qualitative stomach content of cod that provided very valuable information with regard to species interactions and that had been collected since 1947. At the time, the scientific emphasis was on establishing good single-species science for management purposes, and ecosystem data did not receive any attention.

The organization of scientific cooperation is here taken to mean the way research cooperation is actually practised. Because it is so central to the cooperation, the role of ICES merits special attention. In 1959 ICES established the ICES Arctic Fisheries Working Group (AFWG)[58] where Norway, the Soviet Union, Germany and the UK participated. Initially, the group concentrated on cod and haddock, but later also included other species. Cooperation through ICES gradually widened in scope, with additional meetings, assessment groups and committees.[59] Eventually, several arenas of cooperation were developed, such as ICES meetings, joint scientific meetings, joint scientific symposia and joint surveys. ICES has been an important platform for developing the cooperation and also for discussions within a broader international context.[60] By 1971 assessment of the cod and haddock stocks of the North East Atlantic had become an annual exercise of the AFWG.[61]

The establishment of yearly bilateral surveys also stimulated regular annual meetings where physics, biology and technology were discussed.[62] As the cooperation progressed, one of the most important events became the yearly scientific meetings (the "March meetings"), where 10 to 20 Russian and Norwegian scientists meet to discuss themes proposed by the fisheries commission.[63] The location of

56. Gjøsæter 2011. Norwegian scientists started this survey in 1972.
57. Røttingen and Gjøsæter 2009; Schwach 2000: 288.
58. ICES AFWG 2009: 10.
59. Jakobsen and Ozhigin 2011: 22.
60. Ibid.
61. Holm and Nielsen 2004.
62. Røttingen and Gjøsæter 2009.
63. Røttingen et al., 2007.

these meetings alternates between Russia and Norway, and a scientific programme is produced at each year's meeting, following up upon what is agreed in the Joint Commission. The demand for better knowledge on how to regulate fish stocks increased in the wake of the establishment of EEZs. This led to an upgrading of the role of ICES, and the Council became central in the standardization of ocean and fisheries science in the North Atlantic. TACs based on Virtual Population Analysis (VPA) became the management "technology" of the organization, underlying most of the scientific advice provided to member countries and organizations. According to Kåre N. Nielsen,[64] VPA enabled TAC management that could produce more accurate forecasts of potential catches. In response to the developing role of ICES as an advisory body for management, an Advisory Committee on Fishery Management (ACFM) was established in 1977.[65]

5.3. 1980–1998: Computer Technology and Multispecies Mindset

Until 1981 the emphasis in the cod stock estimates had been on commercial catch data, with the results of the acoustic surveys used merely as backup or additional information. Large discrepancies between commercial catch data and acoustic survey data from 1977 to 1980 had led ICES to recommend stronger emphasis on survey data. In order to improve the validity of the survey data, an additional bottom-trawl survey was to run parallel to the acoustic survey from 1981. The idea was that two data sources would be more reliable, especially if they showed similar results.[66] Experience had shown once and for all that commercial catch data were not sufficiently reliable to base estimates on.[67] The trawling procedure of the 0-group survey was also changed in 1981. The new procedure was more systematic, aimed at covering the entire depth range of the 0-group.[68]

In technology, the 1980s saw the advent of personal computers and wider use of computer technology in general. Also hardware and software for processing acous-

64. Nielsen 2008: 92.
65. Ibid.
66. Nakken 2008: 109.
67. The same discrepancy between scientific data and commercial catch data re-appeared in 1996. The commercial data indicated lower fishing mortality and a larger population. Once again, emphasis was placed on the commercial data, and this led to an underestimation of fishing mortality in 1995–1996. The TAC that was set for the following years, based on these assumptions, was too high – an error of judgement that became obvious when the catch and survey data for 1997 were analysed.
68. Instead of 1 nm distance, towing time was 10 minutes, at 3 knots, equivalent to approximately 0.5 nm, as opposed to the previous 1 nm.

tic and other data were developed.[69] Because of the opportunities that computers brought to the cooperation, the IMR lent computers to PINRO.[70] According to one of our informants, relations between Russian and Norwegian scientists became closer with the combination of improved English and internet access among the Russian counterparts.

Calibration and intercalibration of the acoustic instruments, previously a tedious and time-consuming process, became easier and more efficient in the early 1980s.[71] Prior to 1985, the trawls in use varied considerably in size, according to vessel size and propulsion power. Since 1985, all vessels have used identical "standard" trawls with a rectangular mouth opening of about 15x20 metres.

In 1982 "Population models – ecosystem investigations" was a new theme in the scientific programme.[72] This entailed a broadening of scope and a trend towards holistic thinking. It was becoming clear that, for instance, marine mammals could have a greater impact on fish stock dynamics than previously assumed. In 1984, seals were included in the joint research programme, as they are an important predator on cod.[73]

Another clear indication that the single-species focus was too narrow was the failure of the 0-group survey index for cod. The index had been matched with stock numbers at age 3, and the correlation turned out to be good – and so it was used to estimate future recruitment to the cod stock.[74] Then the collapse of the capelin stock in the mid-1980s upset this, as the lack of capelin led to increased cannibalism among the cod. An important lesson had been learnt: the focus would have to be expanded if one was to be able to understand the population dynamics. As it turned out, also sea temperature played an important role in recruitment success, as well as the size of the spawning stock.[75]

According to one of the participating scientists, the idea of developing a joint database on multispecies science came from the Norwegian side. It was, however, the Russian scientists who had been collecting stomach samples for a long time already. As explained by one: "This is an important prerequisite for understand-

69. Nakken 2008: 129.
70. Interview with scientist at the IMR, Bergen, 18 January 2011.
71. Nakken 2008: 150.
72. Fellesprogram (Joint program) 1982.
73. Fellesprogram (Joint program) 1984.
74. Nakken 2008: 130.
75. Ibid.,133.

ing species interactions, and I think we totally sample approximately 10 000 cod stomachs per year."[76]

Selectivity trials on trawl gear were included in the joint research in 1982. This was an area of conflict and therefore an important issue, remaining so throughout the 1980s. It continued to be a joint scientific task until 2010.[77]

In 1985, species interaction constituted a separate point on the scientific agenda for the first time. The aim was to discuss how to increase and improve knowledge on the interaction of the most important commercial species.[78] Seal–fish, cod/haddock–capelin, cod/haddock–shrimp and herring–capelin were relationships that were addressed in the beginning. The value of the previously mentioned Russian time-series on stomach sample dating back to 1947 was becoming evident, particularly when Norwegian scientists started to look into multispecies modelling early in the 1980s.[79] Towards the end of that decade, the idea of species interaction and ecosystem interconnectedness resulted in the development of multispecies models for the Barents Sea. Russian scientists have all along worked with a model originating from the Baltic Sea, MSVPA (Multispecies Virtual Population Analysis), seeking to adapt it to the Barents Sea. The Norwegians developed the MULTISPEC model – that is, an area distributed multispecies model.[80] According to one informant, " […] maybe, if we had been open to the Russian ecosystem data in 1978, we would have embarked on a more common track with regard to multispecies modelling from the beginning."[81]

Since 1983, every third or second year a symposium has been held in the Norwegian–Russian fisheries science symposium series. The themes for the symposia vary. Initially, they were intended solely for scientists from IMR and PINRO. Today also scientists from other Russian and Norwegian institutes participate, as do representatives from the fishing industry and fisheries management. The symposium in 1986 focused on how oceanographic conditions affected distribution

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76. Interview with N.N. Bergen, January 18, 2011. The Russian analysis had been qualitative, but also quantitative analyses were included in the joint database.
77. Russian scientists wanted more trials before considering the increased mesh size regulations requiring selectivity devices on their vessels. While the Norwegian fishing fleet took about one third of their quotas with trawl and the rest with conventional gear, the Soviet Union fleet used trawls in cod and haddock fisheries. Restrictions on trawl gear would therefore affect Soviet vessels more than Norwegian ones. The Soviet side therefore argued that the cod stock should rather be protected in the spawning grounds, in the Lofoten archipelago in the Norwegian zone. That would represent a major disadvantage to Norwegian fisheries.
78. Fellesprogram (Joint programme) 1985.
79. Haug et al., 2007: 18.
80. Stiansen et al., 2005/2006.
81. Interview with scientist at the IMR. Bergen, 18 January 2011.

and population dynamics of the commercial fish populations. This emphasized the shift towards more holistic thinking, which also implied including other types of experts, such as oceanographers, in addition to fishery biologists.

In the early 1990s, red king crab was discussed at the meetings of the Joint Commission.[82] The crab was included in the scientific cooperation in 1992, and in 1994 a research quota was established, divided between Norway and Russia.[83] The main task then was to establish whether the crab was sufficiently abundant to allow for commercial exploitation.[84]

During the 1990s, domestic regulatory measures in the two countries were gradually harmonized. Among other things, there was coordination of the conversion factors for fish products. These factors help convert the weight back to round fish, and such harmonization is very important for shared commercial stocks.[85] Other developments have included an exchange programme on cod otoliths between the IMR and PINRO, started in 1992.[86]

Despite the formal structure around this cooperation, our interviewees emphasized the importance of personal relations in this scientific cooperation. According to one authority, "I have a feeling that in order to get fruitful scientific discussions, personal relations are more important with Russians than with other nations we work together with. This is why we have encouraged achieving this."[87]

5.4. 1998–2011: The Precautionary Approach and the Ecosystem Approach

Although ecosystem modelling proved very complicated, some multispecies models have been successfully applied in management. Since 1998, ICES has employed a simplified version of the MULTISPEC multispecies model in setting the TAC for capelin in the Barents Sea. The input data to the model comes from acoustic surveys, and the TAC has been estimated according to how much capelin will be consumed by cod.[88]

82. Hønneland 2006: 73.
83. Ibid., 49.
84. Joint Program 1993.
85. Hønneland 2006: 58–59.
86. Later a similar programme has been running on haddock, Greenland halibut and capelin, ICES AFWG Report 2006: 5.
87. Interview with scientist at the IMR, Bergen, 17 November 2011.
88. Another model (SYSTMOD) has been developed to address the connection between herring, capelin and cod and climate changes. The model aims to grasp how warm periods favour recruitment and growth of all of these species, combined with how large year-classes of herring mean large predation on capelin larvae.

In 1998 other marine mammals in addition to seals were included in the joint investigations.[89] The reason was twofold: to get more knowledge on the species, and to find out more on how much fish they consumed. Today, both specialized sealers and whalers are used in the marine mammal investigations. In addition, coast guard vessels do sighting surveys and telemetric tagging surveys. A helicopter is used for harp seal tagging in the White Sea.[90]

The red king crab became increasingly central in the joint work after the turn of the millennium, and in 2004 it was the subject of the joint scientific symposium. This also meant that VNIRO became more involved in the cooperation, as red king crab research is an area where VNIRO is heavily engaged. The red king crab is an invasive species: It has now become an important commercial resource, but it is also a threat to the marine ecosystem.[91]

In 2000 the Fisheries Commission was able to set a fixed cod TAC for three years ahead, 2001–2003. The background was that ICES had implemented the precautionary approach (PA) into their advice in 1998, and in 2000 the Commission decided to introduce F_{pa}[92] as a reference point for the upper fishing mortality limit on cod. For the scientists, this entailed finding the right precautionary reference points for the stocks. In 2002 a Harvest Control Rule (HCR) for cod and also haddock was developed. The HCR reflected the ICES operationalization of a PA where both the estimated spawning stock biomass and the estimated fishing mortality were considered.[93] Since 2003 Harvest Control Rules have been instrumental for quota decisions for all the joint Barents Sea stocks, except Greenland halibut, where no HCR has yet been established.[94] ICES is currently poised to supplement the Precautionary Approach reference points with a modernized version of the Maximum Sustainable Yield (MSY).[95]

In 2004, the "entire ecosystem" was added to the primary investigations of the joint research as a restructuring towards implementing the Barents Sea management plan. In fisheries science this includes assessing the effects that the fisheries represent to the ecosystem and the effects that human activity represent to the fisheries. This broadened the scope of the research enormously and brought a large number of non-commercial species into the investigation. Climate change and pollution are measured with the aim of revealing possible effects on ecosystems

89. Joint program, Programme of joint Russian–Norwegian investigations in 1998.
90. Joint Norwegian–Russian scientific programme 2005.
91. Ough et al., 2011.
92. $F_{pa} = F_{precautionary\ approach}$.
93. Hønneland 2006: 68–70.
94. Jakobsen and Ozhigin 2011: 36.
95. "Inside out" 2010: 2.

and economic activities. Moreover, research on the benthos is included to reveal possible negative effects of trawling. In other words, the ecosystem approach involves a shift of focus, from single-species research towards the interconnectedness within and among ecosystems. As an adaptation to the introduction of the ecosystem approach to Norwegian marine management, the Norwegian Institute of Marine Research started a re-organization in 2002, inter alia creating several science groups and three ecosystem-based programmes.[96]

Introducing the ecosystem approach also changed the organizational structure of the research. The 0-group surveys have since 2004 evolved into ecosystem surveys, where five vessels from both Norway and Russia monitor the oceanography, biomass, distribution, climate and trophic interactions of the living resources of the Barents Sea. It includes a bottom-trawl survey and an acoustic survey for all the species, including non-commercial ones.[97] The survey is conducted in August/September every year in a coordinated programme.[98] Several additional institutions are involved in processing the data from these surveys, and scientists from various disciplines are involved. The scope has been expanded, not only with regard to scientific focus, but also as to the actors involved.[99]

As an accommodation to the transition towards an ecosystem approach, the ICES advisory council (ACFM) was reconstituted as an Advisory Committee (ACOM) in 2007. This was part of a reform process that had taken place since 1998, stimulated by the need for more holistic marine management.[100]

Another problem that has been influencing the research is the illegal, unreported and unregulated (IUU) fishing of cod and haddock that had been growing in the Barents Sea since the mid-1990s. Eventually the Norwegian Directorate of Fisheries prepared an estimate of unreported landings and based on this, ICES included unreported catches in its stock assessments for 2002 to 2005.[101] In 2002 Russia and Norway started an exchange of information of landings in third countries.[102] In the joint scientific programme, issues like conversion factors emphasize

96. Misund et al., 2005.
97. ICES AFWG 2010:8.
98. Haug et al., 2007: 7.
99. Røttingen et al., 2007.
100. Stange et al., 2012.
101. ICES AFWG Report 2006: 4. This resulted in 15 000–166 000 tons being added to the officially reported landings of Northeast Arctic cod during the years 2002–2008 (Aanes et al., 2011).
102. Hønneland 2006: 80.

a focus on control. Eventually, the combat of IUU fishing succeeded: in the AFWG 2010 report,[103] IUU fishing was estimated at zero.[104]

The data acquired from the bilateral cooperation constitute some of the longest time-series within the ICES. For instance, PINRO has collected data on Barents Sea temperature since 1900, the Kola section, and this time-series has been used in more than 50 scientific publications about the influence of abiotic factors on the ecosystem.[105] It is evident that the time-series data strengthen this science production – but they also make it vulnerable to change. The fact that Norwegian scientists have been denied access to Russian waters threatens the validity of the time-series, and likewise with the difficulties experienced by PINRO in getting funding for their research. On the other hand, according to one informant, "On any account, a lot has fallen into place lately after a long time; we have come to agreements on minimum size, mesh size and grids in trawls."[106]

6. Discussion

The most striking feature of development in scientific substance is the increase in scope over the years. This can be seen from tables 1 and 2, which show the increase in number of primary and secondary species, along with focus areas. In the beginning of the cooperation in the Joint Commission, only a few commercial species were subject to investigation. Over time, more and more species have been included – such as the red king crab, the polar cod and the Greenland halibut. However, the most striking addition to the primary investigations is the ecosystem, which expands the scope to include assessments of wider ecosystem components and threats. The data and information acquired through these surveys are used to make ecosystem assessments where the effects of various human activities are of major importance.

The substantial increase in secondary investigation species is an indication of how complexity has increased: It is no longer sufficient to assess only the commercial species, but also the species linked to these must be taken into account.

103. ICES AFWG Report 2010.
104. This statement is, however, followed by a note mentioning that there had been disagreements in the study group regarding the mandate. There had for instance been no joint inspection of each other's data, and this had been reported to the JNRFC for a clarification: AFWG therefore expects that Norway and Russia will continue the work to secure the necessary quality and accuracy of the catch statistics. Inspections at sea need to be an important part of this work, and Norway and Russia have checkpoints in their respective economic zones where all fishing vessels have to pass (ICES AFWG 2010: 7).
105. Haug et al., 2007: 25.
106. Interview with scientist at the IMR, Bergen, November 17, 2011.

Table 1: Development in primary investigation species from 1979 to 2011

1979	1982	1984	1990	1993	1998	2000	2004	2005	2006	2008	2010	2011
											Harbour seal	Harbour seal
							Grey seal	Grey seal	Grey seal	Grey seal	Hooded seal	Harp seal
							Humpback whale	Humpback whale	Humpback whale	Humpback whale	Grey seal	Hooded seal
							Harp seal	Harp seal	Harp seal	Harp seal	Harp seal	Cartilag-inous fish
							Dolphin	White whale	White whale	White whale	Salmon	Salmon
					Hooded seal		Greenland halibut	Greenland halibut	Greenland halibut	Greenland halibut	Greenland halibut	Greenland halibut
					Harp seal		Ecosystem	Ecosystem	Ecosystem	Ecosystem	Ecosystem	Ecosystem
					Minke whale	Minke whale	Minke whale	Minke whale	Minke whale	Minke whale	Minke whale	Minke whale
					Polar cod	Polar cod	Polar cod	Polar cod	Polar cod	Polar cod	Polar cod	Polar cod
				Red king crab	Red king crab	Red king crab	Red king crab	Red king crab	Red king crab	Red king crab	Red king crab	Red king crab
			Blue whiting	Blue whiting	Blue whiting	Blue whiting	Blue whiting	Blue whiting	Blue whiting	Blue whiting	Blue whiting	Blue whiting
		Seal	Seal	Seal	Seal	Seal	Seal	Seal	Seal	Seal	Seal	Seal
		Squid	Squid	Squid	Squid	Squid	Squid	Squid	Squid	Squid	Squid	Squid
redfish	shrimp	shrimp	shrimp	shrimp	shrimp	shrimp	shrimp	shrimp	shrimp	shrimp	shrimp	shrimp
(herring and blue whiting)	(herring and blue whiting)	(herring and blue whiting)	(herring)	(herring)	(herring)	(herring)	(herring)	(herring)	(herring)	(herring)	(herring)	(herring)
Capelin	Capelin	Capelin	Capelin	Capelin	Capelin	Capelin	Capelin	Capelin	Capelin	Capelin	Capelin	Capelin
Haddock	Haddock	Haddock	Haddock	Haddock	Haddock	Haddock	Haddock	Haddock	Haddock	Haddock	Haddock	Haddock
Cod	Cod	Cod	Cod	Cod	Cod	Cod	Cod	Cod	Cod	Cod	Cod	Cod

Table 2: Development in secondary species of investigation from 1998 until 2011

1998	2004	2005	2006
			Spotted catfish
			Dolphin
		Ice condition	Grenadier
		Macrozoobenthos	Ice condition
		Flounders	Macrozoobenthos
		Long Rough dab	Long Rough dab
		S.mentella	S.mentella
		Plaice	Plaice
	Oceanographic parameters	Oceanographic parameters	Oceanographic parameters
	Chlorophyll	Chlorophyll	Chlorophyll
	Birds	Birds	Birds
	Marine mammals	Marine mammals	Marine mammals
	Mackerel	Mackerel	Mackerel
Minke whale	Lumpsucker	Lumpsucker	Lumpsucker
Hooded seal	Flatfish	Flatfish	Flatfish
Harp seal	Skates	Skates	Skates
Plaice	Tusk	Tusk	Tusk
Grenadier	Redfish	Redfish	Redfish
Skates	Catfish	Catfish	Catfish
Redfish	Zooplankton	Zooplankton	Zooplankton
Wolffish	Saithe	Saithe	Saithe
Mackerel	Sebastes marinus	Sebastes marinus	Sebastes marinus

Some of these secondary species may be added because they are "indicator species," which means changes to these may be a symptom of a more substantial shift.

The list of secondary species ranges from the smallest to the largest: we note plankton, an important source in the food chain; benthic organisms that can provide much information on bottom-trawling for instance; oceanographic parameters; and marine mammals.

The increase in scope also reflects developments in science and technology. Science plays an important role in agenda setting by identifying and highlighting problems that arise from the human use of natural resources and environmental

2008	2010	2011
		Crabs
		Benthic organisms
		Spotted catfish
Other cetaceans		Other pinnipedia
Walrus (other pinnipedia)		Walrus
Bearded seal	White whale	Other marine mammals
Snow crab	Other cetaceans	Wolffish
Spotted catfish	Walrus (other pinnipedia)	Plaice
Benthic organisms	Bearded seal	White whale
Northern Wolffish	Snow crab	Common seal
Ice condition	Spotted catfish	Grey seal
Long Rough dab	Northern Wolffish	Ringed seal
S.mentella	Ice condition	Bearded seal
Plaice	Long Rough dab	Snow crab
Oceanographic parameters	S.mentella	Northern Wolffish
Chlorophyll	Oceanographic parameters	Long Rough dab
Birds	Chlorophyll	S.mentella
Marine mammals	Birds	Oceanographic parameters
Mackerel	Marine mammals	Chlorophyll
Lumpsucker	Mackerel	Birds
Flatfish	Lumpsucker	Marine mammals
Skates	Flatfish	Mackerel
Tusk	Skates	Flatfish
Redfish	Redfish	Redfish
Catfish	Catfish	Catfish
Zooplankton	Zooplankton	Zooplankton
Saithe	Saithe	Saithe
Sebastes marinus	Sebastes marinus	Sebastes marinus

services.[107] New discoveries lead to new challenges, while new technology may provide ways of dealing with these challenges. The development of sonar technology, for instance, has revolutionized fisheries science, making it possible to "see" under the sea surface. Computer science has made data processing easier, in turn leading to greater efficiency as well as the possibility of expanding the scope within the frame of the fisheries cooperation. Importantly, however, there must be ways for including new discoveries and new technology into science and management. According to Oran R. Young, solving such problems requires the creation of suitable institutional arrangements. Steinar Andresen and Willy Østreng have under-

107. Young 1989: 10.

lined the role of science in the formation of some international regimes, noting that the process is often moved forward by the scientific community.[108] This constitutes an interdependent process, whereby science influences the international regimes, technology creates opportunities for development, and development is implemented into managerial science. The relationship that has been revealed between cod and capelin is one example of scientific findings that led to changes in how we conceive of relations among and between ecosystem components, and had implications for management. However, greater understanding does not necessarily lead to reduced uncertainty in scientific advice: Complexities and uncertainty may instead become even more evident.[109] In general, we may say that the international regimes have contributed to a standardization of fisheries management and therefore also fisheries science.

When Norway and Russia established a bilateral commission by means of a Fisheries Agreement in 1975, the purpose was joint management of transboundary stocks. The Norwegian–Russian Joint Fisheries Commission sets TACs and allocates them each year. Following the adoption of the 1995 UN Fish Stocks Agreement the Precautionary Approach (PA) was widely introduced in the North East Atlantic. ICES was instrumental in operationalizing the concept, making it applicable to practical resource management. There was, however, a subsequent discussion between the Joint Commission and ICES where particularly the Russian side felt the PA quotas were overly cautious.

Another major influence on scientific cooperation is the Ecosystem Approach. Originally introduced as a tool for sustainable development and conservation of living natural resources, it has been adapted to fisheries management by the UN's Food and Agriculture Organization (FAO).[110] It represents changes since it is based on the interconnectedness of the properties of ecosystems. For science this entails firstly an assessment of the entire ecosystem, and secondly the assessments of the effects of all human actions on the ecosystem and its constituents. The implications for science are huge, but for this particular scientific cooperation, the transition towards ecosystem management has been met by the establishment of an annual ecosystem survey. The same Norwegian and Russian scientists are involved in the actual survey, but the data produced are now also used by some new actors. The scope of those who gain access to the results and data has thus increased, as new types of experts are required in order to produce a report on the status of the entire ecosystem.[111]

108. Andresen and Østreng 1989: 12.
109. Andresen 1989: 32.
110. FAO 2005.
111. Stiansen et al., 2009.

In the Norwegian–Russian scientific cooperation, the ICES ACOM serves as the advisor to the Norwegian and Russian authorities in relation to measures such as Total Allowable Catches. The scientific advice is tailored to the system of the setting of annual Total Allowable Catch quotas.[112] This has an impact on the organizations producing the formal knowledge for fisheries management, as they become a part of the fisheries management systems in the countries receiving the advice.[113] To initiate policy and convey scientific knowledge into the decision-making processes is highly dependent upon the organization of the relationship between science and politics.[114] In this regard ICES functions as a cornerstone in the joint scientific cooperation.[115] While Norwegian and Russian scientists conduct the collection of data on commercial fish populations, ICES working groups play an important role in reviewing the science, in practice functioning as an international peer review body. That means that ICES carries out international quality control of the scientific activities, and Norwegian and Russian scientists work together within the ICES system to develop a shared understanding of models and data collection.[116] Figure 3 presents a timeline of the relationships between the international regimes, organization through ICES and developments in Norwegian–Russian production of science.

This figure[117] is intended to show scientific developments over time, while also indicating the international driving forces. We can see clearly that during the 1980s and 1990s the scientific tasks were becoming stamped by the roles they were increasingly set to serve.

This role involves providing scientific advice to management, and therefore the scope of the tasks is widened incrementally. With the emphasis of this science production moving towards providing advice aimed at maintaining exploited fish stocks at healthy levels, the focus is directed towards assessing factors that can be influential. The result is an expansion of the scope to include other organisms as well as abiotic factors and anthropogenic factors.

Fisheries science has undergone dramatic developments since the 1950s and 1960s. This reflects new discoveries due to greater knowledge, new technologies and the recent shift towards including broader environmental considerations in fisheries management and fisheries science. Today's cooperation under the Joint

112. Holm and Nielsen 2004.
113. Degnbol 2003 (32).
114. Andresen and Østreng 1989: 1.
115. Røttingen et al., 2007.
116. Ibid.
117. Figure drawn by Maria Hammer on the basis of reports from the UN, FAO, JNRFC, Joint scientific programs, ICES, Joint report series and Riksrevisjonen.

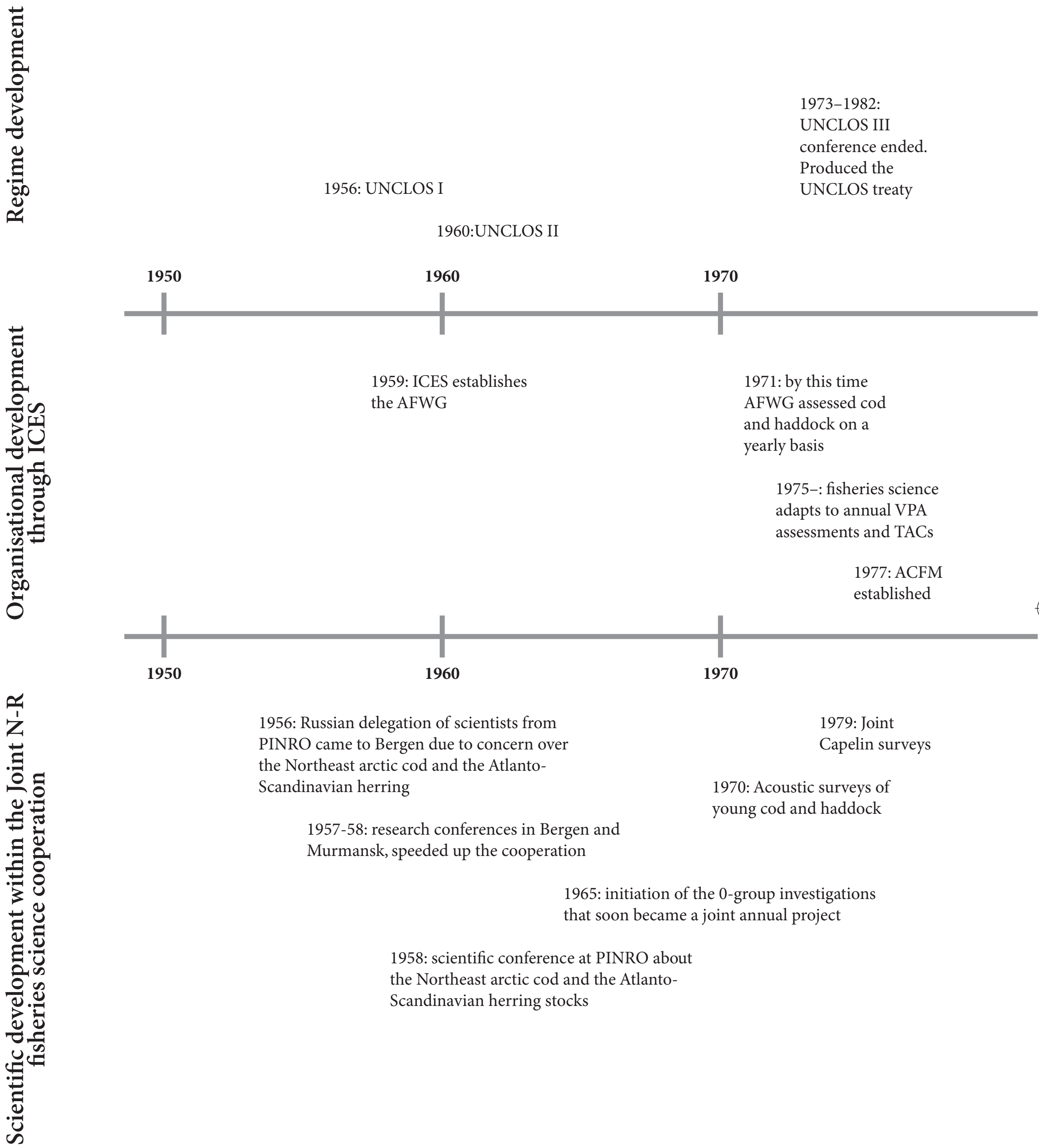
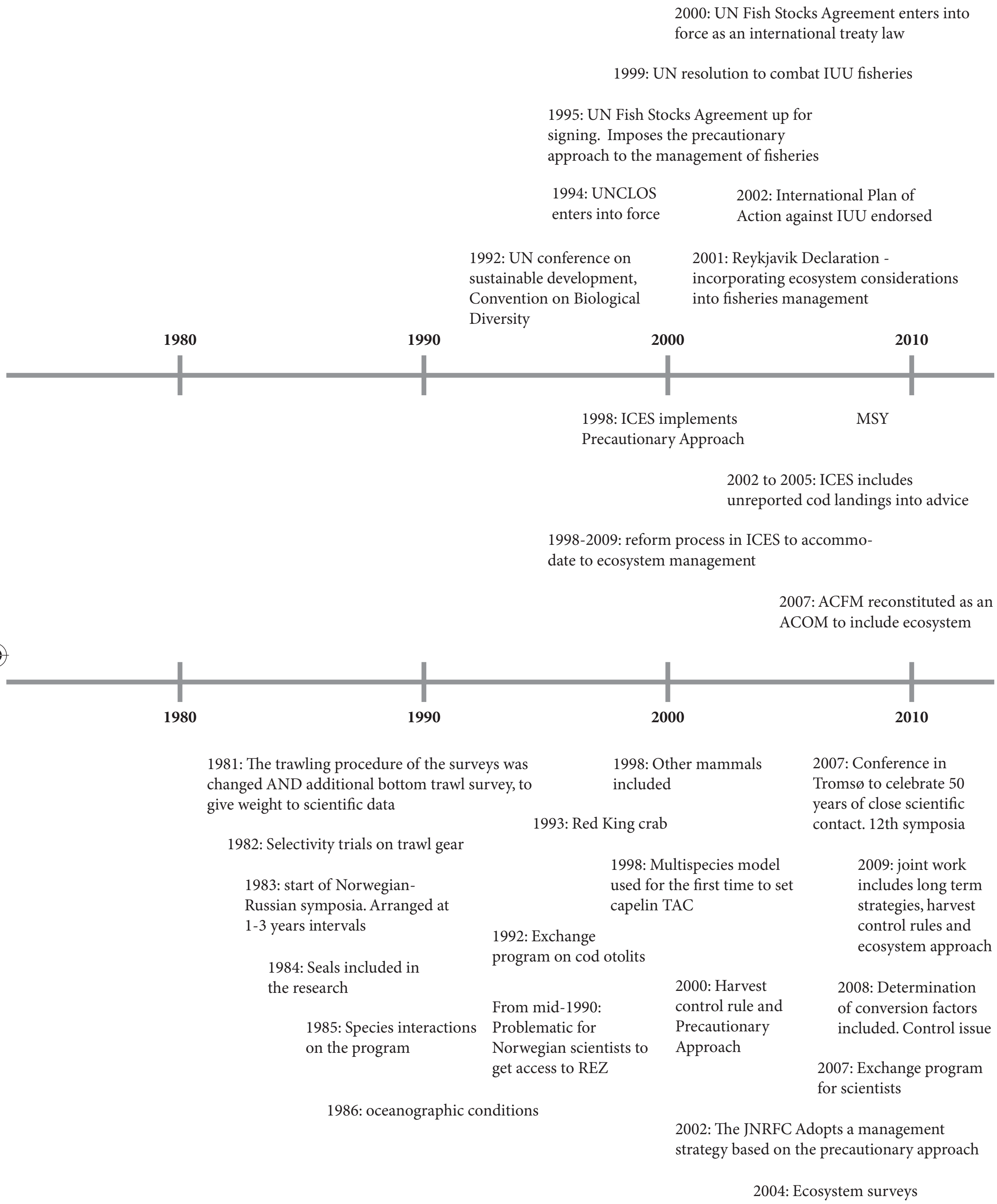

Regime development
1973–1982: UNCLOS III conference ended. Produced the UNCLOS treaty
1956: UNCLOS I
1960:UNCLOS II
1950
1960
1970
Organisational development through ICES
1959: ICES establishes the AFWG
1971: by this time AFWG assessed cod and haddock on a yearly basis
1975–: fisheries science adapts to annual VPA assessments and TACs
1977: ACFM established
1950
1960
1970
Scientific development within the Joint N-R fisheries science cooperation
1956: Russian delegation of scientists from PINRO came to Bergen due to concern over the Northeast arctic cod and the Atlanto-Scandinavian herring
1979: Joint Capelin surveys
1970: Acoustic surveys of young cod and haddock
1957-58: research conferences in Bergen and Murmansk, speeded up the cooperation
1965: initiation of the 0-group investigations that soon became a joint annual project
1958: scientific conference at PINRO about the Northeast arctic cod and the Atlanto-Scandinavian herring stocks

Figure 3



2000: UN Fish Stocks Agreement enters into force as an international treaty law
1999: UN resolution to combat IUU fisheries
1995: UN Fish Stocks Agreement up for signing. Imposes the precautionary approach to the management of fisheries
1994: UNCLOS enters into force
2002: International Plan of Action against IUU endorsed
1992: UN conference on sustainable development, Convention on Biological Diversity
2001: Reykjavik Declaration - incorporating ecosystem considerations into fisheries management
1980
1990
2000
2010
1998: ICES implements Precautionary Approach
MSY
2002 to 2005: ICES includes unreported cod landings into advice
1998-2009: reform process in ICES to accommodate to ecosystem management
2007: ACFM reconstituted as an ACOM to include ecosystem
1980
1990
2000
2010
1981: The trawling procedure of the surveys was changed AND additional bottom trawl survey, to give weight to scientific data
1998: Other mammals included
2007: Conference in Tromsø to celebrate 50 years of close scientific contact. 12th symposia
1993: Red King crab
1982: Selectivity trials on trawl gear
1998: Multispecies model used for the first time to set capelin TAC
2009: joint work includes long term strategies, harvest control rules and ecosystem approach
1983: start of Norwegian-Russian symposia. Arranged at 1-3 years intervals
1992: Exchange program on cod otolits
1984: Seals included in the research
2000: Harvest control rule and Precautionary Approach
2008: Determination of conversion factors included. Control issue
From mid-1990: Problematic for Norwegian scientists to get access to REZ
1985: Species interactions on the program
2007: Exchange program for scientists
1986: oceanographic conditions
2002: The JNRFC Adopts a management strategy based on the precautionary approach
2004: Ecosystem surveys

Commission in fisheries science between Norway and Russia started with a shared concern over fish stocks. The cooperation has expanded into a larger framework involving shared concern for the marine environment as well. This development has implied incremental change. One such change has been the inclusion of scientists from other fields in addition to fishery biology.

International regimes have been important drivers for developments here, since they include provisions relating to science. ICES has been another important driver, particularly in terms of providing a common platform for developing the scientific perspectives underlying the cooperation between Norwegian and Russian scientists.[118] In addition it has served in part as a "translation institute" between science and policy, as its advisory committee formulates the scientific advice that goes to the authorities in the two countries.

This cooperative fisheries management arrangement is generally considered successful.[119] Most major fish stocks in the area are now at a high level, and, compared to other marine regions, the Barents Sea stands out as a model for sustainable management and use of living marine resources.

Fundamentally, the cooperation is based on the strong shared interest of the two countries in managing the resources of the Barents Sea in a way that can provide a sustainable yield of resources for their fishing industries. There is much to be gained from cooperation here. The set of agreements and the establishment of a commission lend a permanency and long-term perspective to the cooperation. In addition, agreement on the science among scientists from the two countries makes it more difficult for decision-makers to ignore the scientific advice. By agreeing on the methods, data and models, the two countries have developed a common understanding of the status of fish stocks and their future. Such agreement on the factual basis for management is important in this context, offering valuable lessons for fisheries management in general.

118. Hoel, Alf Håkon 2008: Best practices in fisheries management: experiences from the Norwegian–Russian fisheries cooperation. I: *The New Northern Dimension of the European Neighborhood*. Brussels: Center for European Policy Studies, pp. 54–70.

119. Krog 2011.

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Развитие научного сотрудничества в рамках российско-норвежского режима управления рыбными ресурсами Баренцева моря.

Мария Хаммер, соискатель степени доктора философии, Кафедра политологии, Университет г. Тромсе *Maria.hammer@uit.no*

Альф Хокон Хуль, Директор регионального отделения, Институт Морских Исследований, Тромсе *alf.haakon.hoel@imr.no*

Резюме

Сотрудничество между норвежскими и российскими учеными в области морских исследований в Баренцевом море уходит корнями в 1950-ые годы. С тех пор, наука, а также управление ресурсами, которое она призвана обеспечивать, достигли впечатляющих результатов. Содержание предметов исследования и методик существенно расширилось. Ранее, всего несколько

видов промысловых рыб являлись объектом научных исследований. Сегодня – это вся экосистема; некоммерческие, а также коммерческие виды. Другой аспект изменений имеет отношение к организации научных исследований: в то время, как сотрудничество изначально носило спорадический характер, оно постепенно стало частью более широкой научной кооперации и приобрело более организованный характер. Эта кооперация явяляется частью системы двустороннего управления живыми морскими ресурсами Баренцева моря. Смешанная Российско-Норвежская Комиссия по рыболовству и Международный совет по исследованию моря (ИКЕС) являются научными рецензентами и консультантами для органов власти Норвегии и России. Данная научная статья рассматривает этот процесс в его связи с разитием в науке, международных режимах, а также ролью науки в принятии политических решений.